*REMARKS*

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| The following claims are pending in the application: | 1 – 17 |
| The following claims have been amended: | 1, 3 - 17 |
| The following claims have been cancelled or withdrawn: | N/A |
| The following claims have been added: | 18 - 21 |

As a result of the foregoing Amendment, the following claims remain pending in the application: 1 - 21.

Brief Description of Claim Amendments

Claims 4 and 5 have been amended to clarify their dependency upon claim 3, and to supply proper punctuation. Claim 13 has been amended to clarify its dependency upon claim 12.

Claims 1 and 3 - 17 have also been editorially amended to more clearly describe and point out the claimed invention.

The Rejection Under 35 U.S.C. §112, Second Paragraph

The Examiner has rejected claims 2 – 9, 11, 12, 14, and 15 under 35 U.S.C. §112, second paragraph by taking the position that the claims do not particularly point out and distinctly claim Applicant's invention.

In this regard, the Examiner has taken the position that claims 6 and 7 are unclear because the term "the calculated value of phycocyanin" is not referred to in claim 1. In order to clarify the claims, Applicant has amended claims 1, 3 – 17 to more clearly point out that the method of the present invention determines the amount of phycocyanin-

pigmented algae or bacteria through the application of an algorithm that relates the amounts of light in the respective bands as claimed to the amount of phycocyanin-pigmented algae or bacteria in the water. This determination is clearly through an algorithmic calculation such as is exemplified in the specification.

To be consistent, Applicant has amended the claims to refer consistently to the determination of the amount of phycocyanin-pigmented algae or bacteria, as supported by the specification for instance on page 6 of the Specification which relates:

> The invention includes a method of determining the presence of phycocyanin algae or bacteria in water from light reflected therefrom. The method comprises the steps of: (a) obtaining a measurement of reflected light from the water, the measurement comprising a measurement of the respective amount of light in at least two, preferably five frequency ranges; and (b) relating the approximate amount of the phycocyanin in the water to the respective amounts of light by applying an algorithm relating the respective amounts of light in the at least two, preferably five frequency ranges to the amount of phycocyanin algae or bacteria in the water. This may be expressed in colonies per milliliter or otherwise through appropriate adjustment of the magnitude and dimensions of the algorithms described herein or generated by the present method. It will be understood that the expression of the amount of phycocyanins in terms of colonies per ml water is only one of several ways to express the amount, and that reference to mathematical equivalents refers to any mathematically or logically related algorithms or expressions.

As can be seen from this passage, phycocyanin algae or bacteria are referred to as "phycocyanins." The amount of the chemical phycocyanin itself of course directly correlates to the amount or colonies of phycocyanin-containing algae or bacteria containing it, and that the invention includes the use of any equivalent algorithmic expressions that arrive at the subject determination.

Claims 4 and 5 have been amended to depend from claim 3 which contains reference to the variables X, $K_1$, $K_2$, etc.

Claims 6 and 7 have been amended to state that it is the "determined amount of said phycocyanin-pigmented algae or bacteria" (referred to in claim 1 as having been determined by application of the algorithm), and that that determined amount correlates to the claimed degree with an actual measured amount. In this regard, the specification mentions that amounts of phycocyanin-pigmented algae or bacteria obtained by the inventive method correlate well with amounts the actual measured amount of the phycocyanin in the water. See page 8 of the Specification.

The Examiner has also stated that it is not clear what property of each of the LANDSAT TM band or atmospheric haze is involved in the algorithm. Applicant respectfully submits that it is the amount of light within each band that is the property of the light referred to. Applicant respectfully submits that one of ordinary skill would appreciate this from the specification and the claims that expressly set this forth. With respect to haze correction, Applicant respectfully submits that the Specification sets forth the method by which the light measurements from each band are haze corrected:

> It was determined that the use of the single band radiances (even if they were reduced to spectral reflectances from theoretical atmospheric models) as inputs to this procedure, the resulting algorithm would not be very robust (i.e., repeatable under different solar illumination and atmospheric conditions). Therefore, spectral ratios (ratios of spectral bands, after empirical correction for atmospheric haze through a process referred to as "dark object subtraction," were input to the mathematical procedure for each pixel from which a water sample had been collected. These 15 non-reciprocal ratios (R21, R31, R32, R41, .....R75) became the dependent variables and phycocyanin became the independent variable, which was the result of lab analysis of the water samples. See the Specification, pages 20 -21.

Accordingly, Applicant submits that the amended claims are in compliance with Section 112, second paragraph in this regard.

Finally, the specification and originally submitted claims have been amended to clarify that the reflected light is taken from a wavelength or wavelength range rather than a frequency or frequency range, as is clear from the context of the claims and specification, which refers to these parameters/ranges in distance, such as micrometers, the dimensions of wavelength. This amendment accordingly corrects an obvious error and does not serve to insert new matter into the specification, particularly as both the wavelength and frequency of light are related to the speed of light, such that the specification of one inherently specifies the other.

In light of the foregoing amendment and remarks, Applicant respectfully submits that claims 1 - 17 are now in clear compliance with 35 U.S.C. §112, second paragraph, and these grounds for rejection may properly be withdrawn.

The Rejections Under 35 U.S.C. §103

The Examiner has rejected claims 1, 4 - 11, 13, 16, and 17 under 35 U.S.C. §103(a) as allegedly being unpatentable over Richardson (Bioscience, Vol. 46, No. 7, pages 492-501) in view of O'Mongain et al. (US Patent No. 6,028,663), and further in view of Gitelson et al. (1995, Journal of Phycology, Vol. 31, No. 5, pages 828 - 834).

The Examiner also has rejected claims 1 - 17 under 35 U.S.C. §103(a) based on the further citation of the Landsat 7 Science Data Users Handbook (August 7, 2001).

The Examiner has taken the position that "several research groups have used various sensors, including Landsat TM, for the detection of algae and photosynthetic bacteria according to reflectance spectra (citing pages 494 – 495, particularly Figure 1)." The Examiner also points out that Table 3 on page 498 lists frequency ranges used with

various remote sensors, where bandwidths of the Landsat-5 remote sensor are the same as those listed in claim1 and 16. The Examiner concludes that by the use of satellites such as the Landsat-5 and SeaWiFS sensors, transmittal of data occurs, where the reflectance data is related to the approximate amount of phycocyanin. The Examiner also taeks the position that Figures 2 and 3 of this reference demonstrate the generation of a report of approximate amounts of phycocyanin apparent by the peaks of the reflectance spectra.

The Examiner acknowledges that the Richardson reference does not expressly disclose application of an algorithm to relate reflectance to the amount of phycocyanin-pigmented algae or bacteria in the water.

The Examiner relies on the O'Mongain reference for its disclosure of a photometric analysis method for water suspensions where spectra are obtained of light transmitted and absorbed. This method is said to allow for the estimation of blue-green algae level from the height of the single phycocyanin peak (column 3, lines 8 – 10 and column 12, lines 39 – 42). Furthermore, the Examiner states that a fitting algorithm is used for phycocyanin presence, where approximate amount of phycocyanin is related to the amounts of light (column 8, lines 18 – 45).

The Examiner relies upon the Gitelson reference for its disclosure of the "creation of algorithms" for remote estimation of biomass and pigment concentration in cyanobacteria.

From these references, the Examiner concludes that, at the time the invention was made, one of ordinary skill would have "recognized that the methods of Gitelson and O'Mongain would have been suitably applied to the data obtainable by Richardson and

thereby provided an appropriate quantification of phycocyanin and biomass quantities. The Examiner reasons that one of ordinary skill would have been motivated to do this "since O'Mongain and Gitelson provide a reasonable expectation that the data obtainable by the methods reviewed by Richardson could be used to quantify phycocyanin and biomass amounts in large bodies of water." The Examiner also concludes that "[i]t provides a more accurate approach for accomplishing the goal described in Richardson of assessing algal population dynamics."

With respect to claims 1 – 17, the Examiner further cites the Landsat 7 Science Data Users Handbook (August 7, 2001). The Examiner concludes that this Handbook discloses the wavelength limits of the Landsat 5 TM bands, and notes that "the bandwidth ranges are of the same frequency ranges as those given in (sic) [the claims?]."

Applicant respectfully submits that the cited references could not fairly be combined to reach the claimed invention at the time the invention was made.

In this regard, Applicant first points out that the Richardson reference not only fails to mention the application of any algorithm to relate reflectance to the amount of phycocyanin-pigmented algae or bacteria in the water, it completely fails disclose all of the bandwidth ranges to which the claimed invention of claims 1 – 17 as amended refers. Reference to Figure 1 on page 494 of this reference show that phycocyanin is not referred to at all in the absorbance spectra given. No data is given for wavelengths above 600 nm, and LANDSAT TM bands 4, 5 and 7 referred to in the claims 1 – 17 all lay above 600nm. See Table 8.1.1 in the cited Landsat Users Handbook. Rather, the Richardson reference points only to a *single* absorbance band at about 630 nm. Figure 2

on page 495 also points to only a *single* absorbance band at about 630 nm, and this graph extends only to 908 nm, still well below LANDSAT TM bands 5 and 7.

Accordingly, the primary reference Richardson fails to teach or suggest the application of any algorithm (other than a direct correlation to the 630 nm band) to arrive at a measure of phycocyanin, and completely fails to contain any suggestion to use any wavelengths beyond 630 nm, and certainly not those wavelengths in 3 of the LANDSAT TM bands referred to in the claims.

The same is true of the Gitelson reference which points only to *single* wavelength at 624 nm as relating to phycocyanin estimation (and teaching only two wavelengths in the *alternative* for chlorophyll a), again well below the wavelengths of LANDSAT TM bands 4, 5 and 7 referred to in the claims. The other wavelength range of 670 to 950 nm is said to be used as a baseline above which reflectance is related to biomass generally, rather than to any specific pigmented microorganism. Accordingly, Applicant respectfully submits that one of ordinary skill in the art would not have found it obvious to proceed from the cited references to use wavelengths as specified in claims 1, 12 and 16. In addition, the Examiner relies upon the Gitleson reference for its alleged teaching of the "creation of algorithms for remote estimation of biomass and pigment concentration in cyanobacteria." However, Applicant respectfully submits that the Gitelson reference gives no guidance regarding the nature of any algorithm or the methodology for the development of any algorithm.

The O'Mongain reference does not cure any of the deficiencies of the primary reference, as it relates only to the identification of a *single* phycocyanin pigment spectral peak which is indicative of blue-green algae occurring at 628 nm.+/-.3. The

O'Mongain reference also appears to relate only to the measurement of algae through light absorbance in a tubular device and does not teach or suggest the measurement method of the present invention that relates to the measurement of reflected light. Rather, it appears that the O'Mongain reference relates only to absorption measurements, and thus would not be of direct relevance to determinations upon reflectance as in the present invention (which makes remote sensing possible). This reference therefore provides no additional teaching that would fill the voids in the primary reference with respect to the wavelength selection and algorithmic application.

Finally, the cited Landsat 7 Science Data Users Handbook (August 7, 2001), even though mentioning some of the same frequency ranges as those given in the claims, gives no further guidance as to which Landsat bands to use, nor does it teach or suggest anything with respect to the development of any algorithm to interpret reflectance value in those ranges. Accordingly, Applicant respectfully submits that this Handbook cures none of the deficiencies of the other cited references.

Applicant has also added claims 18 and 21 that are directed to another related method of the present invention. Support for these claims may be found for instance on pages 6, 11 and 21 – 22 of the specification relating to the use of reflectance from more at least two wavelengths, and ratios among them relating to the amount of phycocyanin algae or bacteria. In this regard, the method of the present invention includes the use of at least two wavelengths of light, and the relation of reflectance values at those wavelengths to the amount of phycocyanin algae or bacteria. Applicant respectfully submits that these claims are also novel and unobvious in comparison to the prior art of record.

In this regard, the prior art does not teach or suggest the application of an algorithm to at least two reflectance values from the given wavelength ranges as in claims 18 and 19, nor does the prior art teach or suggest the use of two ratios constructed from three reflectance values taken at different respective wavelengths, as in claims 20 and 21.

In summation, Applicant respectfully submits that the cited prior art would not suffice to place the claimed invention in the hands of one of ordinary skill, at the time the invention was made.

*CONCLUSION*

In view of the foregoing amendment and accompanying remarks, Applicant respectfully submit that the present application is properly in condition for allowance and may be passed to issuance upon payment of the appropriate fees.

Telephone inquiry to the undersigned in order to clarify or otherwise expedite prosecution of the subject application is respectfully encouraged.

Respectfully submitted,

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